

1 WHAT IS CLAIMED IS

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1. A method of fabricating a semiconductor device, comprising the steps of:

forming a gate electrode on a substrate;

forming a diffusion region in said substrate

10 adjacent to said gate electrode;

forming a side wall oxide film on a side wall of said gate electrode;

forming an interlayer insulation film on said substrate such that said interlayer insulation film covers said gate electrode and further said side wall oxide film; and

15 forming a self-aligned opening in said interlayer insulation film such that said self-aligned opening exposes said diffusion region;

20 said step of forming said self-aligned opening comprising the steps of:

forming a first insulation film of an oxide such that said first insulation film covers said side wall oxide film and said diffusion region;

25 depositing a second insulation film having a composition different from a composition of said first insulation film, on said first insulation film;

forming said interlayer insulation film on said second insulation film;

30 forming a contact hole in said interlayer insulation film in correspondence to said diffusion region by an etching process while using said second insulation film as an etching stopper;

removing said second insulation film exposed at a bottom of said contact hole by an etching process while using said first insulation film as an etching stopper; and

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1 removing said first insulation film exposed
at a bottom of said contact hole selectively with
respect to said diffusion region;

wherein said step of forming said first
5 insulation film is conducted by a plasma CVD process,
with a high-frequency power set smaller than a high-
frequency power in which said first insulation film
contains H₂O with an amount of about 2.4 wt%.

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2. A method as claimed in claim 1, wherein
said high-frequency power is set smaller than a high-
15 frequency power in which said first insulation film
contains H₂O with an amount of about 1.1 wt% or less.

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3. A method as claimed in claim 1, wherein
said high-frequency power is set smaller than about
100 W.

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4. A method as claimed in claim 1, wherein
said high-frequency power is set between about 50 W
30 and about 100 W.

35 5. A method as claimed in claim 1, wherein
said first insulation film has a refractive index of
about 1.5.

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1 6. A method as claimed in claim 1, wherein
said plasma CVD process is conducted while using SiH_4
and N_2O as source materials, with a proportion of N_2O
with respect to SiH_4 set to be about 10 or less.

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10 7. A method as claimed in claim 1, further
including a step, after said step of forming said
first insulation film and before said step of forming
said second insulation film, of annealing said first
insulation film.

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20 8. A method as claimed in claim 7, wherein
said annealing step is conducted by a rapid heating
process.

25 9. A method as claimed in claim 1, wherein
said step of forming said first insulation film and
said step of forming said second insulation film are
conducted in a common reaction vessel, without a step
of taking out said substrate outside said reaction
30 vessel.

35 10. A method as claimed in claim 1,
wherein said step of forming said diffusion region
includes a step of forming a silicide on a surface of

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1 said diffusion region, and wherein said step of
forming said silicide is conducted before said step of
forming said first insulation film.

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11. A method as claimed in claim 1, further
comprising a step, before said step of forming said
10 first insulation layer, of forming a conductor pattern
in contact with said diffusion region.

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12. A method of fabricating a semiconductor
device, comprising the steps of:

forming a gate electrode on a substrate;

forming a diffusion region in said substrate

20 adjacent to said gate electrode;

forming a side wall oxide film on a side
wall of said gate electrode;

forming an interlayer insulation film on
said substrate such that said interlayer insulation
25 film covers said gate electrode and further said side
wall oxide film; and

forming a self-aligned opening in said
interlayer insulation film such that said self-aligned
opening exposes said diffusion region;

30 said step of forming said self-aligned
opening comprising the steps of:

forming a first insulation film of an oxide
such that said first insulation film covers said side
wall oxide film and said diffusion region;

35 depositing a second insulation film having a
composition different from a composition of said first
insulation film, on said first insulation film;

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1 forming said interlayer insulation film on
said second insulation film;
 forming a contact hole in said interlayer
insulation film in correspondence to said diffusion
5 region by an etching process while using said second
insulation film as an etching stopper;
 removing said second insulation film exposed
at a bottom of said contact hole by an etching process
while using said first insulation film as an etching
10 stopper; and
 removing said first insulation film exposed
at a bottom of said contact hole selectively with
respect to said diffusion region;
 wherein said step of forming said first
15 insulation film is conducted by a CVD process that
uses SiH_4 and N_2O as source gases.

20 13. A method as claimed in claim 12,
wherein said CVD process is conducted while setting a
ratio of N_2O with respect to SiH_4 to about 5 or less.

25 14. A method as claimed in claim 12,
wherein said CVD process is conducted at a substrate
30 temperature of about 825°C or less.

35 15. A method as claimed in claim 12,
further including a step, after said step of forming
said first insulation film and before said step of

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1 forming said second insulation film, of annealing said
first insulation film.

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16. A method as claimed in claim 12,
wherein said annealing step is conducted by a rapid
heating process.

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17. A method as claimed in claim 12,
15 wherein said step of forming said first insulation
film and said step of forming said second insulation
film are conducted in a common reaction vessel,
without a step of taking out said substrate outside
said reaction vessel.

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18. A method as claimed in claim 12,
25 wherein said step of forming said diffusion region
includes a step of forming a silicide on a surface of
said diffusion region, and wherein said step of
forming said silicide is conducted before said step of
forming said first insulation film.

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19. A method of fabricating a semiconductor
35 device, comprising the steps of:
forming a gate electrode on a substrate;
forming a diffusion region in said substrate

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1 adjacent to said gate electrode;
forming a side wall oxide film on a side
wall of said gate electrode;
forming an interlayer insulation film on
5 said substrate such that said interlayer insulation
film covers said gate electrode and further said side
wall oxide film; and
forming a self-aligned opening in said
interlayer insulation film such that said self-aligned
10 opening exposes said diffusion region;
said step of forming said self-aligned
opening comprising the steps of:
forming a first insulation film of an oxide
such that said first insulation film covers said side
15 wall oxide film and said diffusion region;
depositing a second insulation film having a
composition different from a composition of said first
insulation film, on said first insulation film;
forming said interlayer insulation film on
20 said second insulation film;
forming a contact hole in said interlayer
insulation film in correspondence to said diffusion
region by an etching process while using said second
insulation film as an etching stopper;
25 removing said second insulation film exposed
at a bottom of said contact hole by an etching process
while using said first insulation film as an etching
stopper; and
removing said first insulation film exposed
30 at a bottom of said contact hole selectively with
respect to said diffusion region;
wherein said step of forming said first
insulation film is conducted by depositing a silicate
glass containing P.

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1 20. A method as claimed in claim 19,
wherein said silicate glass contains P therein with an
amount of about 6 wt% or less.

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 21. A method as claimed in claim 19,
wherein said silicate glass further contains B.
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 22. A method as claimed in claim 21,
15 wherein said silicate glass contains B with an amount
of about 4 wt% or less.

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 23. A method as claimed in claim 19,
further including a step, after said step of forming
said first insulation film and before said step of
forming said second insulation film, of annealing said
25 first insulation film.

30 24. A method as claimed in claim 23,
wherein said annealing step is conducted by a rapid
heating process.

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 25. A method as claimed in claim 19,

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1 wherein said step of forming said first insulation
film and said step of forming said second insulation
film are conducted in a common reaction vessel,
without a step of taking out said substrate outside
5 said reaction vessel.

10 26. A method as claimed in claim 19,
wherein said step of forming said diffusion region
includes a step of forming a silicide on a surface of
said diffusion region, and wherein said step of
forming said silicide is conducted before said step of
15 forming said first insulation film.

20 27. A method as claimed in claim 19,
further comprising a step, before said step of forming
said first insulation layer, of forming a conductor
pattern in contact with said diffusion region.

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30 28. A semiconductor device, comprising:
a substrate;
a gate electrode provided on said substrate;
a diffusion region formed in said substrate
adjacent to said gate electrode;
a side-wall insulation film formed on a side
wall of said gate electrode; and
35 a self-aligned contact hole defined by said
side-wall oxide film and exposing said diffusion
region;

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1 wherein said semiconductor device further
includes:

5 a first insulation film provided on said
gate electrode so as to cover said side wall oxide
film partially;

a second insulation film having a
composition different from a composition of said first
insulation film and provided on said first insulation
film;

10 an interlayer insulation film deposited on
said second insulation film;

15 a contact hole formed in said interlayer
insulation film, said contact hole extending through
said first and second insulation films and exposing
said self-aligned contact hole;

said first insulation film contains H₂O with
an amount smaller than about 2.4 wt%.

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29. A semiconductor device as claimed in
claim 28, wherein said first insulation film contains
H₂O with an amount of about 1.1 wt% or less.

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30. A semiconductor device as claimed in
30 claim 28, wherein said first insulation film is an
oxide film having a refractive index of about 1.5.

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31. A semiconductor device as claimed in
claim 28, further comprising a conductor pattern

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1 contacting with said diffusion region and said gate
electrode such that said conductor pattern extends
between said side wall oxide film and said first
insulation film along a surface of said side wall
5 oxide film.

10 32. A semiconductor device as claimed in
claim 28, further comprising a silicide layer on a
surface of said diffusion region.

15 33. A semiconductor device as claimed in
claim 32, further comprising a silicide layer on a
surface of said gate electrode.

20 34. A semiconductor device, comprising:
25 a substrate;
a gate electrode provided on said substrate;
a diffusion region formed in said substrate
adjacent to said gate electrode;
a side-wall insulation film formed on a side
30 wall of said gate electrode; and
a self-aligned contact hole defined by said
side-wall oxide film and exposing said diffusion
region;
wherein said semiconductor device further
35 includes:
a first insulation film provided on said
gate electrode so as to cover said side wall oxide

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1 film partially;

a second insulation film having a composition different from a composition of said first insulation film and provided on said first insulation film;

an interlayer insulation film deposited on said second insulation film;

a contact hole formed in said interlayer insulation film, said contact hole extending through said first and second insulation films and exposing said self-aligned contact hole;

said first insulation film is formed of PSG containing P with an amount of about 6 wt% or less.

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35. A semiconductor device as claimed in claim 34, further comprising a conductor pattern contacting with said diffusion region and said gate electrode such that said conductor pattern extends between said side wall oxide film and said first insulation film along a surface of said side wall oxide film.

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36. A semiconductor device as claimed in claim 34, further comprising a silicide layer on a surface of said diffusion region.

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38. A semiconductor device as claimed in claim 36, further comprising a silicide layer on a

1 surface of said gate electrode.

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A semiconductor device, comprising:
a substrate;
a gate electrode provided on said substrate;
a diffusion region formed in said substrate

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adjacent to said gate electrode;
a side-wall insulation film formed on a side
wall of said gate electrode; and

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a self-aligned contact hole defined by said
side-wall oxide film and exposing said diffusion
region;

wherein said semiconductor device further
includes:

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a first insulation film provided on said
gate electrode so as to cover said side wall oxide
film partially;

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a second insulation film having a
composition different from a composition of said first
insulation film and provided on said first insulation
film;

an interlayer insulation film deposited on
said second insulation film;

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a contact hole formed in said interlayer
insulation film, said contact hole extending through
said first and second insulation films and exposing
said self-aligned contact hole;

said first insulation film is formed of BPSG
containing B with an amount of about 4 wt% or less.

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A semiconductor device as claimed in

- 1 claim ³⁸~~39~~, further comprising a conductor pattern contacting with said diffusion region and said gate electrode such that said conductor pattern extends between said side wall oxide film and said first insulation film along a surface of said side wall oxide film.

- 10 ⁴⁰~~41~~. A semiconductor device as claimed in claim ³⁸~~39~~, further comprising a silicide layer on a surface of said diffusion region.

- 15 ⁴¹~~42~~. A semiconductor device as claimed in claim ⁴⁰~~41~~, further comprising a silicide layer on a surface of said gate electrode.

- 20 ⁴¹~~42~~. A semiconductor device as claimed in claim ⁴⁰~~41~~, further comprising a silicide layer on a surface of said gate electrode.

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